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Immediate Water Pollution Control Needs Upper Arkansas River Basin Colorado and Kansas

Federal Water Pollution Control Administration, Dallas, Texas

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IMMEDIATE WATER POLLUTION CONTROL NEEDS

UPPER ARKANSAS RIVER BASIN

COLORADO AND KANSAS

U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTH CENTRAL REGION
DALLAS, TEXAS 75202

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16. ABSTRACT

The purpose of the report is to focus attention on known sources of water pollution in this area and to provide a priority for action to correct existing problems and to prevent future problems.

17. KEY WORDS AND DOCUMENT ANALYSIS

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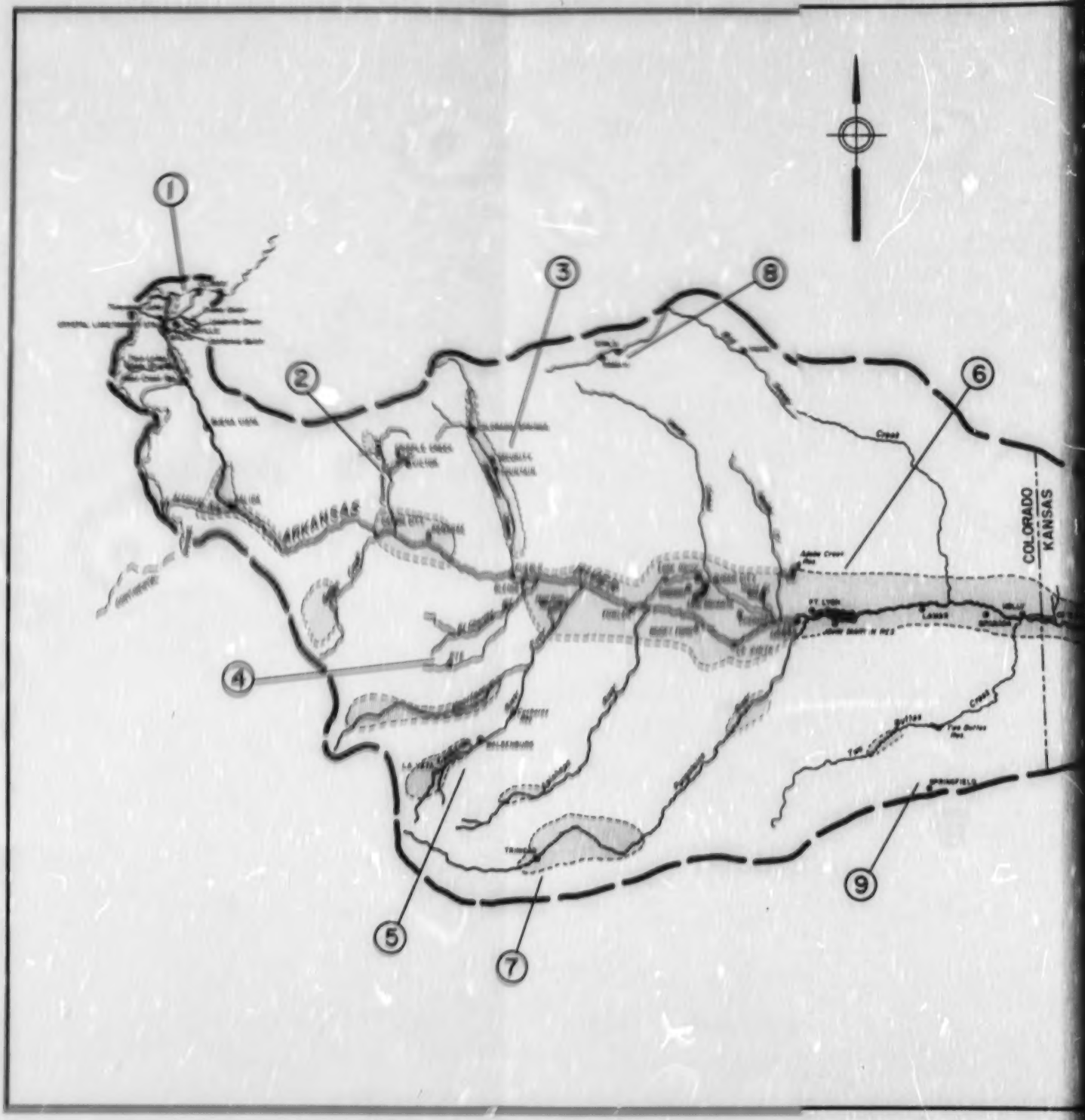
I. Introduction

The purpose of this report is to focus attention on known sources of pollution in the Arkansas River Basin above Great Bend, Kansas, and to provide a priority for action to correct the existing water pollution problems and prevent future problems in the upper reaches of the Arkansas River, an interstate stream, and its tributaries (see Figure 1). This report is based on compilations of available data of the Federal Water Pollution Control Administration, South Central Region, and the pollution control agencies of Colorado and Kansas. No detailed water quality surveys or engineering studies were carried out for preparation of this report.

The findings of this report are based on the best information available at this time on water quality conditions and immediate and potential pollution abatement needs. The omission of any particular town, industry, or other establishment from this report does not imply that an immediate or potential pollution abatement need does not exist in that particular area. Priorities listed are based solely on an evaluation of the Arkansas River Basin above Great Bend, Kansas, and not on a relative basis with other basins in the South Central Region.

Authority is given in Section 3 (a) of the Federal Water Pollution Control Act, as amended, for the preparation or development of comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries thereof and improving the sanitary conditions of surface and underground waters. This report, by describing the immediate needs for controlling water pollution in the Arkansas River Basin above Great Bend, Kansas, represents the first step in the development of a comprehensive program to control water pollution in this basin.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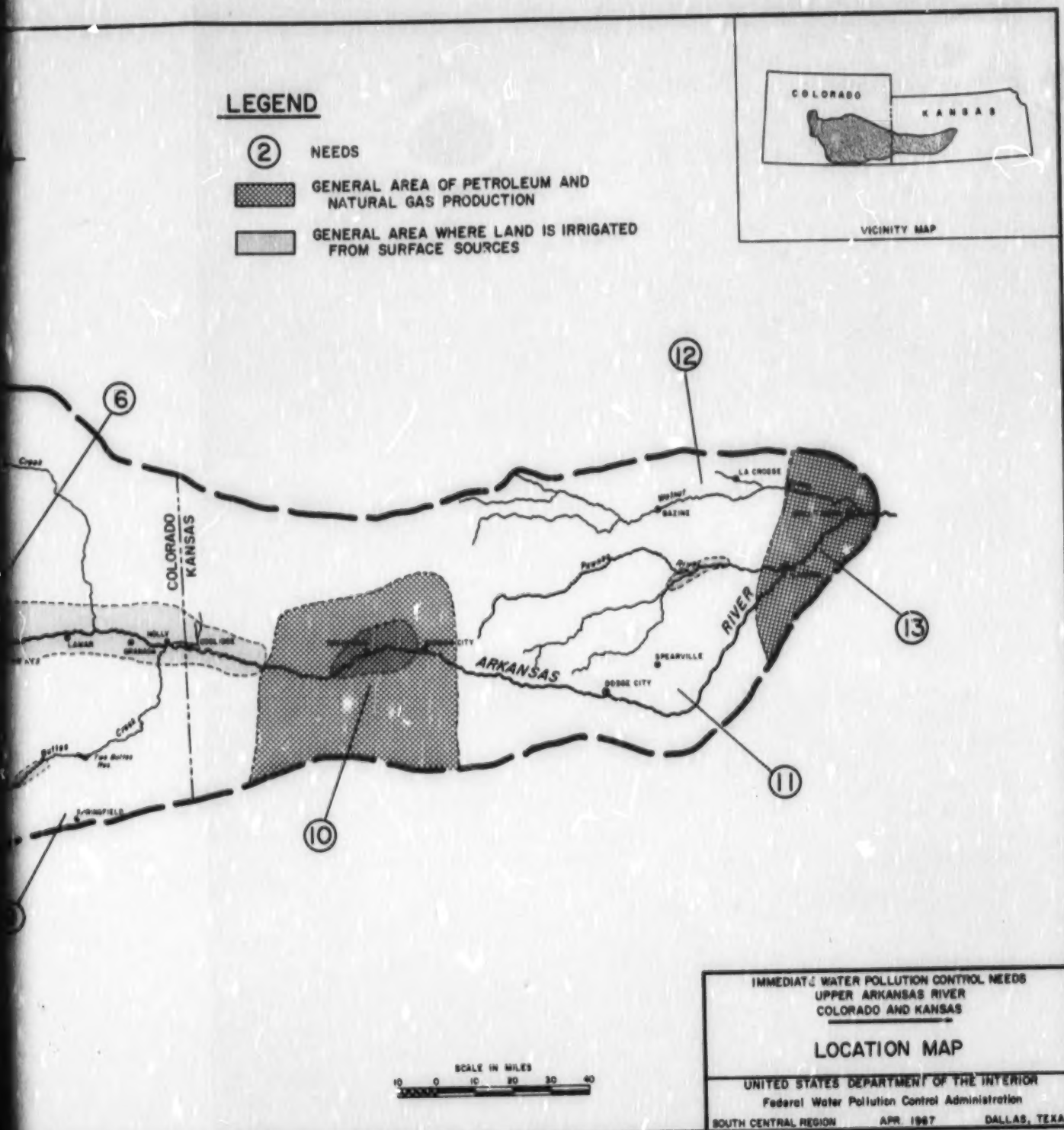

IMMEDIATE WATER POLLUTION CONTROL NEEDS
UPPER ARKANSAS RIVER
COLORADO AND KANSAS

LOCATION MAP

UNITED STATES DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
SOUTH CENTRAL REGION APR. 1967 DALLAS, TEXAS

FIGURE 1

II. Summary of Immediate Pollution Control Needs

Pollution problems in the Upper Arkansas River Basin, as indicated by oxygen depletion, low pH, high heavy metals concentrations, and high mineral concentrations, include damages to propagation of fish life, municipal and industrial water supply, and recreation uses. The immediate pollution control needs are listed in the following tabulation and grouped into categories: waste treatment, other pollution control practices, institutional practices, and research. Location designations refer to Figure 1.

Location	Responsibility	Need	Priority
Waste Treatment - Colorado			
1	U. S. Forest Service, Crystal Lake Ranger Station	Primary & secondary treatment	A
	City of Leadville	Secondary treatment	B
2	City of Cripple Creek	Primary & secondary treatment	A
	City of Penrose	Primary & secondary treatment	A
	City of Victor	Primary & secondary treatment	A
	Royal Gorge Packing Co., (East Canon City)	Connect to city system	B
3	City of Blende	Primary & secondary treatment	A
	City of Colorado Springs	Increase plant capacity	B
	City of Security	Increase plant capacity	B
	City of Fountain	Increase plant capacity	B
	City of Pueblo	Increase plant capacity	B
	Colorado Fuel & Iron Corporation (Pueblo)	More efficient system for removal of oils, phenols, and cyanides	B

Location	Responsibility	Need	Priority
Waste Treatment (Continued)			
4	City of Rye	Secondary treatment	B
5	City of La Veta	Secondary treatment	B
	Shafer Packing Co. (Walsenburg)	Oxidation pond	B
6	American Crystal Sugar Company (Rocky Ford)	Primary & secondary treatment	A
	City of Ordway	Secondary treatment	B
	City of Sugar City	Secondary treatment	B
	City of Granada	Secondary treatment	B
	Diven Packing Co. (Fowler)	Connect to city system	B
	City of La Junta	Add chlorination facilities	B
	Holdbrook Turkey Growers Association (Cheraw)	Solids removal and aeration	B
7	City of Trinidad	Increase plant capacity	B
8	City of Ramah	Secondary treatment	B
	City of Simla	Secondary treatment	B
	City of Hugo	Increase plant capacity	B
9	Caston Butchering (Springfield)	Oxidation pond	B
Kansas			
10	City of Deerfield	Primary & secondary treatment	B

Location	Responsibility	Need	Priority
Waste Treatment - Kansas (Continued)			
11	City of Spearville	Collection system, primary and secondary treatment	A
12	City of La Crosse	Increase plant capacity	B
13	Thies Packing Co., Inc. (Great Bend)	Primary & secondary treatment	A
Other Pollution Control Practices			
Mining and Mineral Outcrop Area Seepage			
Map Location 1 (Evans & California Gulch-Leadville area)	FWPCA and Colorado Water Pollution Control Commission	Locate the source and determine the magnitude of acid and heavy metal emissions and develop required control measures	A
Map Location 1 (South Fork of Lake Creek)	FWPCA and Colorado Water Pollution Control Commission	Locate the source and determine the magnitude of acid emissions and develop required control measures	A
Irrigation Return Flow			
Entire irrigated area (see figure 1), largest concentration between Pueblo, Colorado & Garden City, Kansas	Colorado Water Pollution Control Commission Kansas Water Resources Board	Reduce irrigated acreage to decrease quantity of inorganic pollutants	A

Location	Responsibility	Need	Priority
Animal Feedlot Drainage			
Distributed over entire basin - largest concentration in Dodge City area	Colorado Water Pollution Control Commission Kansas State Board of Health	Examine all feedlot operations and require control of drainage	A
Institutional Practices			
Basinwide	State of Kansas	Increase appropriations to provide additional funds to locate and plug abandoned oil and gas wells	B
Basinwide	States of Kansas and Colorado	Consider legislation to provide appropriations for State participation in grants and loans for construction of sewage treatment works	B
Basinwide	States of Kansas and Colorado	Establish water quality Standards	B
Basinwide	States of Kansas and Colorado	Consider expansion of water quality control surveillance program (including treatment plant operation and maintenance)	A
Basinwide	States of Kansas and Colorado	Prepare and maintain a complete industrial waste discharge inventory for industries not connected with municipal treatment systems.	B
Research			
Basinwide	FWPCA, States of Kansas and Colorado	Determine methods for treating animal feedlot wastes	B

III. Immediate Control Needs

Various measures are needed to control existing and potential water pollution of the Arkansas River and its tributaries. These measures are needed to increase oxygen content, and reduce concentrations of inorganic pollutants for the protection of water uses within the basin in order to improve and preserve water quality for municipal and industrial water supply, propagation of fish and wildlife, recreation, and irrigation uses.

The actions recommended here though not all encompassing are, however, prerequisite to good water quality planning and should be included in local, State, and Federal programming for water pollution control. Background for these immediate needs is summarized in Chapter VI.

Waste Treatment

There are municipalities and industries scattered throughout the river basin that do not provide waste treatment facilities meeting State requirements. To meet the requirements, 9 completely new treatment plants are needed; 8 plants need secondary treatment; 7 plants need additional capacity; 2 plants need oxidation ponds, and 5 plants need modifications in their treatment and/or disposal methods. The list of needs is not considered all inclusive and does not reflect projected needs due to future obsolescence or to expanded or changed water uses.

Other Pollution Control Practices

Heavy metals and acid emissions near Leadville, Colorado, and the headwaters of the South Fork of Lake Creek in Colorado should be studied by FWPCA in cooperation with Colorado Water Pollution Control Commission to determine the extent of damage caused by the pollutants released and, if necessary, methods should be developed to provide control systems that would prevent or minimize damage.

State programs are needed to develop a method for reducing pollution from irrigation return flows. A program could be established to encourage a partial shift in water use from irrigation to industrial applications. A program for promoting more efficient irrigation practices would also be helpful.

State programs are needed to examine all animal feedlot waste disposal practices and require drainage control and/or waste treatment if necessary to prevent stream pollution.

Institutional Practices

To strengthen the States' position on prevention, control, and abatement of stream pollution, water quality standards are needed on interstate and intrastate streams. State participation is needed in the waste treatment plant construction grants program to accelerate the construction of needed improvements. Increased surveillance of municipal and industrial waste treatment plants is needed to locate and identify existing or potential pollution problems. For more rigid control over industrial pollution and to aid in solving complex stream quality problems, a complete and up-to-date inventory is needed of industrial waste discharges, listing quantity and quality of effluent and other pertinent data.

In Kansas, appropriations are needed for locating and plugging abandoned wells that are discharging brines to surface drains or into shallow ground water bodies.

Research

Further research is needed to determine methods for treatment of animal wastes. This research by FWPCA, in cooperation with the States of Kansas and Colorado, is necessary for the control of pollution from animal feedlot runoff.

IV. Costs

The estimated cost of pollution control measures listed in the summary table is shown in the following tabulation:

Item	Estimated Cost
Municipalities:	
New treatment facilities	$ 180,000
Expansion of treatment facilities	2,520,000
Industries:	
New treatment facilities	$ 604,000
Expansion of treatment facilities	1,984,000
State Parks:	
New treatment facilities	$ 12,000
State Program:	
Control mining and mineral outcrop	$ 60,000
Area seepage - This amount is an estimate of the cost of a study to determine the extent of damage caused by the pollutants released and the type of control system needed. No attempt was made to estimate costs for construction of a control system.	
Irrigation Return Flows	$60,000,000

This cost is based on an estimated 150,000 acres of land now irrigated having to be shifted to dry land farming to reduce irrigation to a level where return flow wastes would not seriously degrade the quality of water in the main stem of the Arkansas River. It was further estimated that it would cost an average of $400 per acre to purchase water rights from the landowners. The amount received from resale of water rights to municipalities and industries was not discounted

since resale may not be possible until major quality improvements are effected. This may require 15 or 20 years.

Animal Feedlot Drainage	$ 250,000

The estimate includes only the cost for initial construction of waste retention ponds to prevent slug loads of feedlot drainage from entering streams during heavy rainfall periods. These ponds would not provide "treatment" of the waste. Costs for treatment would greatly exceed the amount shown.

Reduce brine emission from abandoned wells	$ 50,000

The estimate represents an arbitrary amount to be appropriated yearly to be used to plug abandoned wells.

Total Cost	$65,660,000

Of the total cost, approximately $60,360,000, exclusive of research costs, would be needed for control measures listed under priority "A" in the summary table.

V. Recent Progress in Pollution Control

Pollution control agencies in the States of Colorado and Kansas have been very successful in encouraging proper disposal of municipal and industrial wastes. Over 90 percent of the population is served by sewage treatment plants that provide secondary treatment. Operation of these plants is monitored by State control agencies and assistance is provided where needed.

Industries are encouraged to use municipal systems, where feasible, so that very few industries discharge wastes directly to surface drainage courses.

In the Arkansas River Basin in the State of Colorado, 12 new municipal waste treatment plants have been completed since 1957 and 7 plants have been expanded. Approximately $4,000,000 of the construction was eligible for Public Law 660 grants. In Kansas, 22 new plants have been completed and 6 plants have been expanded. Approximately $6,000,000 of this construction was eligible for Public Law 660 grants.

These actions have resulted in a minimum of water quality degradation from municipal and industrial wastes releases. However, water quality deterioration persists as described in Chapter VI.

VI. Background

Pertinent Basin Characteristics

The Arkansas River originates on the eastern slopes of the Rocky Mountains in Lake County, Colorado. From its source, the river drops rapidly through a relatively narrow canyon until it emerges through the Royal Gorge near Canon City into the Great Plains region. From the foot of the mountains to Pueblo, the average fall of the river bed is about 18 feet per mile, while downstream from Pueblo, it averages 7½ feet per mile. The total drainage area of the river watershed above Great Bend, Kansas, is 33,986 square miles, and the length of the main stem is about 575 miles. The river is fed largely by melting snows at its head in the Rocky Mountains and by transbasin diversions (see Table 1). The annual average flow at Canon City is about 500,000 acre-feet while the average annual flow at the Colorado-Kansas State line is less than 300,000 acre-feet. The entire river flow is used several times for irrigation between Canon City and the Kansas State line. Only residual flows from tributaries are contributed to the river in this reach since practically all of the tributary flows are diverted for irrigation. The average annual discharge from the basin at Great Bend, Kansas, is about 230,000 acre-feet.

Only one reservoir, the Corps of Engineers' John Martin Reservoir (see Figure 1) on the main stem, is of major size. This reservoir is designed to operate as a dual-purpose project for flood control and irrigation. No storage was allocated for quality control, recreation, or fish and wildlife activities. At certain times the reservoir may be empty.

The population of the Upper Arkansas River Basin is approximately 600,000. Major population centers are Canon City, Colorado Springs, and Pueblo in Colorado and Garden City, Dodge City, and Great Bend in Kansas. These cities contain about 40 percent of the total population of the basin.

Water Quality

The chemical quality of the surface waters of the Arkansas River Basin above Canon City, Colorado, is generally excellent, although some localized pollution occurs from acid mine drainage in the area of Leadville. However, due primarily to pollution from irrigation return flows, the mineral quality of surface waters below Canon City is generally very poor. Table 2 shows the mineral

Table 1

Existing Transbasin Diversion Projects a/

Project Name	Period of Diversion Record (years)	Average Annual Diversion (Ac-Ft.)	Diversions Oct 1962-Sept 1963 (Ac-Ft.)
Fremont Pass Ditch	35	527	None
Columbine Ditch	33	1,018	803
Ewing Ditch	56	1,209	290
Wurtz Ditch	32	2,056	1,300
Burk-Ivanhoe Diversion Tunnel	39	4,444	3,700
Twin Lakes (Independence Pass) Diversion Tunnel	29	35,831	31,940
Larkspur Ditch	29	134	12
Medano Ditch b/	NA c/	NA	NA
Hoosier Pass Tunnel d/	12	7,022	9,860

a/ All diversions from Colorado River Basin except Medano Ditch
b/ Diversion from Rio Grande River Basin
c/ Information not available
d/ Diversion to South Platte basin from watershed in Summit County - source of water supply for Colorado Springs.

quality content of Arkansas River water at various locations. The mineral content of tributary streams is similar.

Above Pueblo, basin surface waters are used for trout fishing and other recreational purposes, irrigation, and municipal and industrial water supplies. Below Pueblo use is restricted to irrigation with very limited use for industrial supplies and warm water fisheries.

Table 2 - Chemical Quality of Arkansas River, November 1963 to September 1964

Station	Maximum and Minimum Concentrations 1/ Dissolved Solids mg/l	Dissolved Solids tons/day	Sulfates mg/l	Sodium mg/l	Date of Collection
Colorado					
Canon City	226		39	18	4/14/64
	92		23	4.5	6/10/64
Pueblo	740		369	63	5/12/64
	193		63	14	7/7/64
Nespesta	957		490	85	5/12/64
	296		119	25	7/7/64
La Junta	2,240		1,250	207	5/13/64
	491		199	35	6/11/64
Below John Martin Res.	4,460	34.9	2,530	578	1/1-31/64
	636	955	291	8.3	5/27/64
	2,220	494	1,250	267	Weighted Average

Table 2 - Chemical Quality of Arkansas River, November 1963 to September 1964 (cont'd)

Station	Maximum and Minimum Concentrations 1/ Dissolved Solids mg/l	Dissolved Solids tons/day	Sulfates mg/l	Sodium mg/l	Date of Collection
Kansas					
Coolidge	4,250		2,510	582	8/6/64
	3,690		2,290	539	11/27/63
Dodge City	1,690		937	223	2/13/64
	185		35	10	8/20/64
Great Bend	1,040		493	132	2/17/64
	279		56	17	4/23/64

1/ Maximum and minimum concentrations of dissolved solids are shown. Concentrations of sulfates and sodium are not extreme values but are concentrations observed at the time maximum and minimum dissolved solids concentrations were found.

Source: U.S. Geological Survey

Present Water Quality Problems

The quality of surface waters in the Upper Arkansas River Basin is altered by municipal and industrial discharges, seepage from mining and mineral outcrop areas, irrigation return flows, animal feedlot drainage, and oil and natural gas production wastes. Problems associated with these quality alterations are discussed below:

Arkansas River below Leadville, Colorado

Heavy metals and acids emanating from abandoned mining operations in the vicinity of Leadville, Colorado, are released to surface drainage

Table 3

Mineral Quality-Arkansas River

Pueblo to Holly, Colorado

Water Year 1940-41

Station	Runoff 1,000 acre-ft.	Dissolved Solids mg/l	Dissolved Solids 1,000 tons	Ca mg/l	Mg mg/l	Na mg/l	HCO_3 mg/l	SO_4 mg/l	Cl mg/l	NO_3 mg/l
Pueblo	503	346	237	59	15	18	137	122	7	2.5
Nespasta	568	542	419	92	24	40	165	249	12	4.3
La Junta	108	1,088	160	154	45	99	207	555	27	2.5
Caddoa	310	1,376	580	170	61	158	195	775	36	1.8
Holly	169	2,034	468	217	83	241	243	1,050	81	4.3
Pueblo-Holly*		7.8	2.0	5.3	6.0	17.2	5.2	18.0	8.0	1.7

*Increase in salts and ions, as a result of irrigation, from Pueblo to Holly - Values shown are number of times quantities found at Pueblo is concentrated.

Source: Journal, American Water Works Association

courses. The major portion of these pollutants seem to flow to Evans Gulch and California Gulch and thence are discharged to the Arkansas River.

The Bureau of Reclamation plans to divert water from the Arkansas River, below its confluence with Evans Gulch, but above its confluence with California Gulch, for the Fryingpan-Arkansas project. The river would be diverted into the Twin Lakes Reservoir for subsequent use in power generation, municipal supplies, and irrigation (see Figure 1). Although the flow from Evans Gulch constitutes a very small portion of the total quantity of water that will be routed through the Twin Lakes Reservoir, there is a potential danger that quantities of heavy metals observed in this stream could build up to levels that would later prevent use of water stored in the reservoir for municipal supplies.

The U. S. Fish and Wildlife Service indicate that pollution contributed by California Gulch has not been sufficient to cause apparent fish kills in the Arkansas River for perhaps the last 30 years. However, they indicate that reducing flows by diversion of water above California Gulch could result in significant destruction of aquatic life. The river is now a valuable trout stream from its headwaters to Canon City.

South Fork of Lake Creek

Mountains on the Continental Divide at the headwaters of the South Fork of Lake Creek have exposed rhyolite faces. Iron sulphates are dissolved in water from springs and from snow melts on these exposed faces. These polluted waters flow to Lake Creek and eventually reach the Twin Lakes Reservoir. Estimates of acid loads (H_2SO_4) from the South Fork are as follows: Low flow - 6.6 tons per day; high flow - 3.0 tons per day; total for year - 1,752 tons. Frequently pH is depressed below 5.0 and sulphates exceed 80 mg/l. The U. S. Department of Agriculture, Forest Service, indicates that sports fishing cannot be established in Lake Creek until pollutants are reduced in the South Fork of Lake Creek.

Arkansas River, Pueblo, Colorado to Great Bend, Kansas and tributaries between Pueblo, Colorado and Garden City, Kansas

High mineral concentrations in the Arkansas River and its tributaries prevent use of the streams for dependable municipal or industrial supplies. Mineral concentrations have been raised by returning salt laden irrigation waste water to the streams.

In 1959, 1,014,394 acres were irrigated in the Arkansas Basin above Great Bend, Kansas (see Figure 1). Of this acreage, 460,442 acres were irrigated from surface sources.

The amount of irrigation water available varies considerably from year to year; seldom is the supply adequate. Normal stream flows in the Arkansas River and its tributaries during the summer season are often used entirely for irrigation purposes as well as part of their flood and winter flows conserved in basin reservoirs. The shortage of water results in the use and reuse of irrigation return flows.

The irrigation water returned to the Arkansas River in the section between Pueblo and Holly, Colorado, a distance of about 176 miles, is in excess of 200,000 acre-feet per year. Surveys made in this area starting about 1898 show increases in river water salinity due to the return flows. However, irrigation had been practiced for a number of years prior to the date of the earliest quality records, and a poor quality water was found even at this early date.

Table 3 shows the increase in mineral concentration and the shift in the proporations of various ions of the Arkansas River from Pueblo to Holly, Colorado, caused primarily by irrigation return flows during 1940 and 1941. The resultant poor quality practically precludes use of river water for municipal and industrial purposes below Pueblo.

Table 3 shows that during 1940 and 1941, not only were salts concentrated by water losses but additional quanitities of salts were added by the irrigation process. In fact, the salt content found at Holly was twice that found in the river at Pueblo.

Animal Feedlot Drainage

Fish kills related to animal feedlot operations have occurred in several streams in Kansas.

Animal wastes have long been identified as significant sources of pollution. Investigations by the Kansas State Department of Health have shown that runoff from cattle feedlots following rainfall is characterized by a high biochemical oxygen demand, high ammonia content, and heavy bacterial populations. Pollution from feedlots is transported by surface runoff and therefore discharges to streams only as long as the runoff continues to flow.

This results in a slug load of organic material on a receiving stream that can be damaging, producing nuisance conditions, health hazards, and fish kills.

There are approximately 135 cattle feedlots with over 300 head feeding capacity in the Arkansas River Basin above Great Bend, Kansas. These lots have combined capacities of approximately 200,000 head. About 40 of these lots contain almost 80 percent of the basin's total feeding capacity.

Only a small number of the feedlots in the basin now provide proper waste disposal. The Kansas State Department of Health has discovered the danger involved in feedlot drainage and has been actively engaged in development of a control system. Research is presently underway at Kansas State University and Kansas University to identify and find ways to handle and dispose of animal wastes. The Colorado Water Pollution Control Commission is also considering the need for research projects to determine effective control procedures.

Brine Emission from Abandoned Wells

In Kansas, normally in areas where oil or natural gas has been produced, brine is sometimes forced to the surface through abandoned, improperly plugged, wells. The Corporation Commission has the authority to plug abandoned wells. However, funds are not appropriated for this specific purpose. When brine is observed flowing from a well, the Commission attempts to determine who is responsible for the well. If responsibility cannot be established, the Commission must try to have the well plugged using State funds. Obtaining funds could be difficult and it may be necessary to allow wells to flow uncontrolled. These discharges can cause fish kills in local streams and degrade the mineral quality of receiving streams to such an extent that they could not be used for irrigation or municipal and industrial supplies.

Other Areas

Throughout the Upper Arkansas River Basin there are many small problems of waste pollution in streams receiving waste discharges from communities having inadequate treatment facilities. The communities are tabulated in the summary table and are shown on Figure 1.

Several municipal waste treatment plants discharge their effluent into dry watercourses which convey storm runoff to the Arkansas River or its tributaries. In fact, nearly all tributary streams have experienced periods of zero flow. The Arkansas River has also been dry at times at some locations. Flow-duration curves for the Arkansas River indicate that the flow at Great Bend, Dodge City, and Garden City will be less than 10 cfs, 5, 15, and 35 percent of the time, respectively. It should be noted that when the flow is below 10 cfs, 4 mg/l dissolved oxygen cannot be maintained in the river where these cities discharge secondary sewage treatment plant effluent.

Discharge of sewage treatment plants to any stream that is occasionally dry or experiences periods of extremely low flow can cause local nuisance conditions and could damage the streams' use for recreation or the propagation of fish and wildlife.

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